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ILLINOIS NATURAL HISTORY SURVEY

Quality Assurance Report for Illinois RiverWatch: 1997

Project IDNR EEA9706

Technical Report to the
Illinois Department of Natural Resources
Office of Realty and Environmental Assessment

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Center for Aquatic Ecology Technical Report 98/9

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1. SUMMARY

In this study, the accuracy at which Illinois RiverWatch volunteers sort and count macroinvertebrate samples, the accuracy of macroinvertebrate biotic index values (MBI's) calculated from volunteer data, and the ability of volunteers to record data is investigated for 1997 Illinois RiverWatch data. Illinois RiverWatch volunteers collected data for 300 stream sites across the state from May 1 to June 30, 1997. Seven of the data sets did not pass specified requirements resulting in 293 accepted sets of data for 1997. Thirty percent or 87 of the volunteer-collected macroinvertebrate samples and data sets were randomly selected for quality control verification. The macroinvertebrate samples were sorted and counted by the Quality Control Officer (QC) in a blind study. Thereafter, volunteer data were compared to the QC's data for each sample. Sixty-nine percent or 58 of the randomly chosen volunteer samples met the macroinvertebrate identification accuracy level of at least 80%. Illinois RiverWatch volunteers counted the number of organisms in their samples accurately. Ninety percent or 79 of the samples were counted by volunteers with an accuracy of 80% or greater. MBI values calculated with volunteer-collected data were found not significantly different ($p < 0.05$) from MBI values calculated with QC data for the same sample. Only 10.5 % or 31 of the submitted data sheet sets contained one or more error. Overall, Illinois RiverWatch volunteers were found to collect data at the expected accuracy level of 80%. Recommendations are provided to the program for improving volunteer training in the areas of macroinvertebrate identification and sample counting.

2. INTRODUCTION

Illinois RiverWatch was implemented in 1993 by the Illinois Department of Natural Resources to establish a network of volunteers to collect stream quality data on a statewide basis. Illinois RiverWatch is different from other volunteer stream monitoring programs in the country in that state scientists assisted in design of the sampling and data collection procedures. The participation of state scientists in the development of the program insured the use of the data for scientific purposes.

One important part of any scientific project is the use of quality assurance guidelines and a quality control system. Quality assurance (QA) involves specific data collection procedures that insure that data meet a preset level of confidence or accuracy. Quality control involves the actual steps to insure that data conform to the quality assurance guidelines. Illinois RiverWatch uses the following QA procedures:

1. Illinois RiverWatch assigns site identification numbers to all sites monitored by EcoWatch volunteers. Each site identification number represents the site location information for each Illinois RiverWatch monitoring site. All site identification numbers are catalogued in the Illinois EcoWatch site identification database. This database lists all site numbers and corresponding site information such as stream name, county, longitude/latitude, U.S.G.S. 7 ½ minute topographic map name, range, township, topographic map section number, section quadrant, brief location information, landowner's name and landowner's phone number.

2. To prevent miscellaneous data entry errors, the QC established a three tier data sheet verification protocol. The protocol involves checking data sheets by volunteers at the monitoring site, then by the team leader of the volunteer group, and lastly by Illinois RiverWatch regional staff or EcoWatch Trainers.
3. All persons interested in becoming a volunteer for Illinois RiverWatch must undergo approximately 8 hours of training. Volunteers receive approximately four hours of stream habitat and macroinvertebrate sample collection, and up to 4 hours in Illinois indicator macroinvertebrate identification.
4. All Illinois RiverWatch volunteers must follow stream monitoring procedures as written in the *Illinois RiverWatch Stream Monitoring Manual.*
5. Volunteers record data on standardized data sheets.
6. Volunteers must submit a complete macroinvertebrate sample along with data sheets after each annual stream monitoring event.
7. The QC will verify the identification of a percentage of volunteer-collected macroinvertebrate samples on a yearly basis.

This report discusses the quality of the data collected by Illinois RiverWatch volunteers during the annual assessment period of May 1 through June 30, 1997. Topics of this report include the acceptance of volunteer data sets, the accuracy at which volunteers identify stream macroinvertebrates, volunteer data sheet entry errors, and the accuracy of volunteer macroinvertebrate biotic index values (MBI). Recommendations for improving data quality are also provided to IDNR and administration of Illinois RiverWatch.

3. ACCEPTANCE OF DATA FOR ANALYSIS

The goals of quality assurance for any data collection program are to ensure that (1) samples are collected, preserved and stored properly, (2) data are collected, stored, and managed properly, and (3) all reports reflect the information provided by the data. These steps insure that data and information collected are at levels of quality that meet the needs of the program.

The expected level of accuracy for volunteer-collected data of the Illinois RiverWatch program is 80% accuracy. I chose this level of accuracy based on my experience with biological field work. When using the natural environment as the laboratory for one's work a wide range of variability in the data occurs due to numerous uncontrollable factors. When determining the expected level of accuracy for the Illinois RiverWatch program, I had to consider natural or uncontrollable variability as well as variability due to technical expertise of the data collector, namely the volunteer. Assuming that the average volunteer is a person with very limited knowledge or expertise in the collection of biological data, and that volunteer-collected data is expected to be highly variable, an 80% accuracy rate seemed sufficient.

Bias in a data set is caused by the inconsistent procedural measurement by the operator, or by some kind of inherent inconsistency of the procedure itself (Kelley *et al.*, 1992). I determined procedure inconsistencies by volunteers by reading the notes left on the data sheets by the volunteer and by inspection of the macroinvertebrate sample submitted with the data set. Any data collected from procedures different from the stream monitoring procedures of Illinois

RiverWatch were removed from the program's database. For example, the macroinvertebrate collection procedures of the Illinois RiverWatch require that volunteers collect stream macroinvertebrates from the two most diverse habitats available within the 200-foot monitoring site. If a volunteer collects macroinvertebrates from the same habitat twice, rather than from the two most diverse habitats available, the data set is removed from the database. Also, the program requires the use of specific equipment to collect data. For example, a 12-inch wide D-net with a 0.5 mm mesh size is required to collect macroinvertebrates. If a volunteer uses a net other than a 12-inch D net, for example a 5-foot kick seine with a 0.5-mm mesh size, the data from this site would also be removed. The program requires that volunteers submit the macroinvertebrate sample along with the data sheets after each annual monitoring event. This assures that each stream site has an equal chance of being selected for verification of volunteer macroinvertebrate identification. The macroinvertebrate sample is also the physical evidence of the presence of the organisms collected at the site and is very useful to scientists. If a volunteer fails to submit a complete sample of macroinvertebrates along with the data sheets, the data set is removed. All guidelines regarding the proper collection and submission of data for the Illinois RiverWatch stream monitoring program are listed in the Illinois RiverWatch Quality Assurance Manual.

In the first two years of Illinois RiverWatch stream monitoring program, the Quality Control Officer, Denise B. Stoeckel, Ph.D. (QC) reviewed volunteer-collected data and macroinvertebrate samples. Volunteers were able to collect,

identify, and submit macroinvertebrate samples with a high level of accuracy and success. Beginning in 1997, I instituted and accepted only those data sets that met specific standards. These standards require that volunteers collect data using procedures written in the *Illinois RiverWatch Stream Monitoring Manual* and that they submit a complete sample of macroinvertebrates from their respective stream site. Only seven sets of data or 2.3% out of the 300 sets submitted were removed from the statewide Illinois RiverWatch 1997 data base due to data collection or sampling error (Table 1). These seven sets have been placed in a separate database file for future reference and were not included in any data analysis.

Table 1. List of deleted sites from the official Illinois RiverWatch 1997 data base files.

SITE NUMBER	STREAM NAME	EXPLANATION FOR DELETION
R0100601	Green River	Improper subsample procedure.
R0120801	Spring Creek Tributary	Volunteer monitored wrong site on stream.
R0413201	Copperas Creek	Incomplete/missing macroinvertebrate sample
R0210901	Deer Creek	Incomplete/missing macroinvertebrate sample
R0310801	Prairie Creek	Incomplete/missing macroinvertebrate sample
R0600101	Coon Creek	Improper subsampling procedure
R0706102	West Fork Shoal Creek	Incomplete/missing macroinvertebrate sample

4. VERIFICATION OF VOLUNTEER MACROINVERTEBRATE IDENTIFICATION

I verified the identification of a subset of volunteer collected macroinvertebrate samples to determine the accuracy of identification of macroinvertebrates by volunteers. This information not only provides the program with an estimate on how well volunteers are identifying the 33 indicator stream macroinvertebrate taxa, but also identifies specific problem areas in the training of volunteers.

First, I randomly selected 30% of the macroinvertebrate samples collected by volunteers during one annual monitoring period (May 1 - June 30). Then I sorted and counted each randomly selected macroinvertebrate sample without any prior knowledge of the volunteer's results. Finally, I compareed my information regarding the number and type of taxa within each sample to the data submitted by the volunteer.

4.1 Random Selection of Volunteer Collected Macroinvertebrate Samples.

Thirty percent of the macroinvertebrate samples collected by volunteers in 1997 were randomly chosen from the 293 accepted data sets for verification. Macroinvertebrate samples chosen for verification were selected from each EcoWatch region (Figure 1). Thirty percent of the stream macroinvertebrate samples collected in each EcoWatch region were randomly selected as soon as regional data were submitted.

First, a list of the RiverWatch site identification numbers representing all of the accepted data sets for a region were sorted in ascending order. The

number of sites (N) was then multiplied by 0.30 to determine the 30% of the sites monitored in that EcoWatch region, or N_V. Second, a list of random numbers equal to N_V was generated using the random number generator function of Excel (Microsoft Excel for Windows 95 Version 7.0). For example, 35 samples (N) were collected from the EcoWatch Region 3 in 1997. Thirty percent of 35 is equal to 11 samples (N_V). The random number generator of Excel was directed to determine 11 random numbers from 1 to 35. Macroinvertebrate samples with site identification numbers corresponding to the 11 random numbers were selected for verification. Figure 2 illustrates the steps of randomly selecting volunteer-collected macroinvertebrate samples for verification purposes.

Figure 1. Illustration of the division of the state of Illinois into the 6 EcoWatch regions and the 10 ISIS watersheds.

Illinois EcoWatch Regions **ISIS Watersheds**

Macroinvertebrate samples were randomly selected from each EcoWatch region and not by watershed. The data will be ultimately analyzed by watershed to determine trends in stream quality. Therefore it was necessary to determine if the randomly selected samples represented the actual distribution of volunteer-

collected samples per watershed. Figure 3 shows the comparison of the percentage of randomly selected samples per watershed to the actual percentage of volunteer-collected samples overall per watershed. A Chi-square goodness of fit test yielded a Chi-square value of 0.00578 with 9 degrees of freedom. This value was less than the statistical value of Chi-square where $X^2_{0.05,9} = 16.97$. The results show that the randomly selected macroinvertebrate samples do represent the distribution of RiverWatch stream sites throughout the state.

Figure 2. Random selection of volunteer collected macroinvertebrate samples by the Quality Control Officer of Illinois EcoWatch.

1. Sort regional data file in descending order and enumerate.

1. 0100102	*A hypothetical regional data file.
2. 0210101	
3. 0325001	
4. 0412601	
5. 0503502	
6. 0612301	
7. 0700302	
8. 0811101	
9. 0901802	
10.1011101	

2. Determine 30% of the total number of sites and generate random numbers.

   A. 10 X 0.30 = 3 randomly selected samples.
   B. Use of random number generator of Excel 5.0

3. Select samples with corresponding site identification numbers.

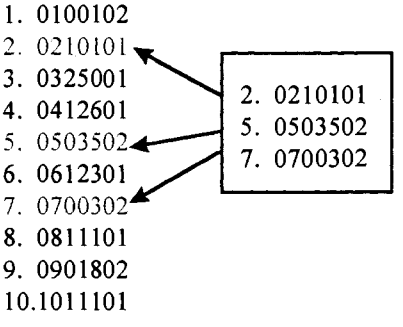
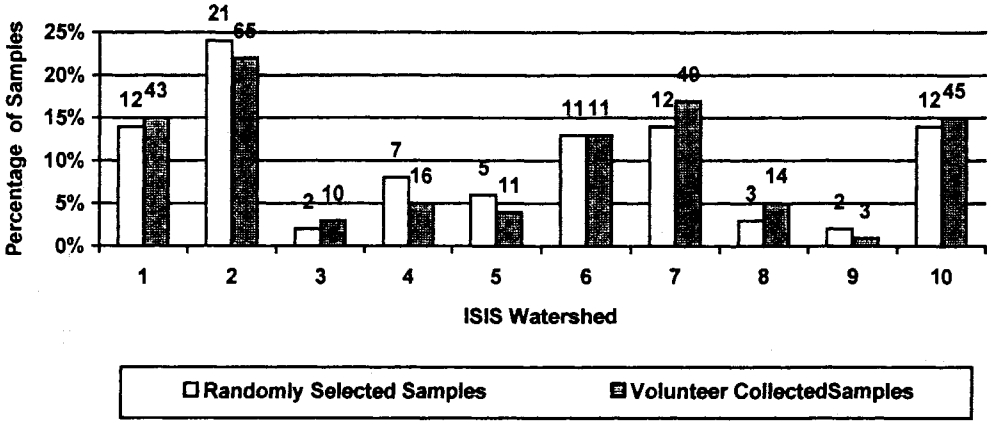


Figure 3. Comparison of the distribution of randomly selected samples with the distribution of samples collected in 1997 on a statewide basis.



Bars represent the percentage of randomly selected samples per watershed and percentage of volunteer collected samples per watershed. Numbers above the bars represent the number of randomly selected samples per watershed and the total number of volunteer collected samples per watershed.

The distribution of randomly selected samples was determined to be not significantly different from the distribution of volunteer collected samples per watershed overall (X^2 = 0.00578, $X20_{.05,9}$ = 16.97, $p < 0.05$).

4.2 Identification Accuracy of Stream Indicator Macroinvertebrate Taxa by Volunteers

Verification of Illinois RiverWatch volunteer samples was conducted as a blind study. I sorted and counted each randomly selected sample without knowing what information the volunteer submitted for each sample. After I counted and identified all 87 randomly selected samples, I compared volunteer data to my data for each sample. Thereafter, I used several statistics to describe the accuracy of volunteer macroinvertebrate identification.

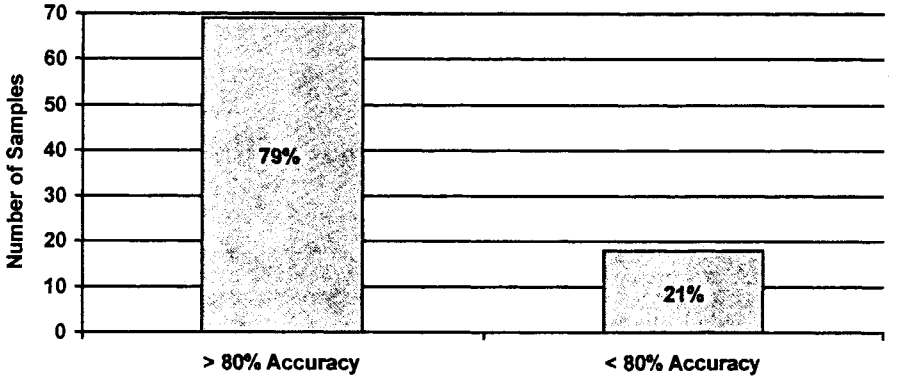
The determination of which taxa were correctly identified by volunteers was somewhat difficult at first. Many times the volunteer and I identified the same taxon in a sample, but the numbers of individuals were different. This mistake was considered a counting error. Counting errors made by volunteers are discussed in Section 4.0 of this report. Therefore, to determine the accuracy at which volunteers identified the 33 indicator macroinvertebrate taxa, I assumed that identification matches between the volunteer and myself represented correct identification of taxa regardless of the number of organisms.

The percentage of correctly identified taxa in each sample varied widely from 100% to 33%. Table 2 and Figure 4 display the accuracy of the 87 randomly selected macroinvertebrate samples. Sixty-nine of the eighty-seven, or 79%, of the randomly selected samples contained 80% or more correctly identified taxa. Therefore, a large majority of the randomly selected samples contained correctly identified taxa.

Table 2. The correct identification of the 33 macroinvertebrate indicator taxa by 1997 Illinois RiverWatch volunteers.

% Correct Taxa in Sample	Number of Samples
100%	39
90% - 99%	5
80% - 89%	25
70% - 79%	11
60% - 69%	4
50% - 59%	1
<50%	2

Figure 4. The number of samples that contained greater than and less than 80% of correctly identified taxa overall.



Numbers within bars represent the percentage of randomly selected samples that had greater than or less than 80% accuracy, overall.

To determine the accuracy rate of identification for each taxon, I used only those samples that contained the taxon. For example, I verified that 75 out of the 87 samples contained midge larvae. Seventy of those 75 samples containing midges were correctly identified by the volunteers. This resulted in a 93% accurate identification rate for midge larvae. Five taxa (stonefly larvae, broadwinged damselfly larvae, adult and larval whirligig beetles, planorbid snails, and water penny beetle larvae) were identified at 100% accuracy by the volunteers. Nine taxa were identified at 90% - 99% accuracy. These taxa were left handed snails, scuds, sowbugs, clinging mayfly larvae, leeches, midge larvae, black fly larvae, hydropsychid caddisfly larvae, and riffle beetle larvae. Eight taxa were identified at 80% - 89% accuracy. These taxa were flatworms, torpedo mayfly larvae, right-handed snails, biting midges, crawling mayfly larvae, aquatic worms, swimming mayfly larvae, and hellgrammites. Therefore, 22 out of the 33 taxa (67%) were identified at 80% or higher accuracy in 1997 by Illinois RiverWatch volunteers. The average accuracy rate overall was 84% accuracy for all 33 taxa. Table 3 displays the accuracy rates of each taxa identified by volunteers of the Illinois RiverWatch stream monitoring program in 1997.

Table 3. Accuracy rates for the identification of each stream indicator macroinvertebrate taxa by volunteers in 1997.

Taxa	Accuracy Rate[1]
BROADWINGED DAMSELFLY	100%
STONEFLY	100%
WHIRLIGIG BEETLE	100%
WATER PENNY BEETLE	100%
PLANORBID SNAIL	100%
SCUD	97%
LEFT-HANDED SNAIL	97%
SOWBUG	96%
CLINGING MAYFLY	95%
LEECH	94%
MIDGE	93%
BLACK FLY	93%
HYDROPSYCHID CADDISFLY	91%
RIFFLE BEETLE	91%
FLATWORM	89%
TORPEDO MAYFLY	89%
BITING MIDGE	88%
RIGHT-HANDED SNAIL	88%
CRAWLING MAYFLY	87%
AQUATIC WORM	84%
SWIMMING MAYFLY	83%
HELLGRAMMITE	80%
DRAGONFLY	75%
NARROWWINGED DAMSELFLY	73%
OTHER FLY	73%
NONHYDROPSYCHID CADDISFLY	71%
BLOODWORM	71%
BURROWING MAYFLY	67%
LIMPET	67%
TWO-TAILED MAYFLY	57%
CRANE FLY	55%
OPERCULATE SNAIL	40%
SNIPE FLY	N/A

[1] *Accuracy Rate = Number of samples containing correctly identified taxa per number of samples found to contain that taxa by the Quality Control Officer.*

4.3 Volunteer Identification Errors of Stream Indicator Macroinvertebrate Taxa

Three different conditions of volunteer identification errors were determined:

1. False Identification: The volunteer identified a taxon as present in the sample while I did not.
2. Missed Identification: I identified a taxon as present in the sample while the volunteer did not.
3. Mixed Identification: A taxon identified by me was mistaken for a similar looking taxa by the volunteer.

The following text describes Illinois RiverWatch volunteer macroinvertebrate identification error based on the three conditions listed above.

4.3.1 Condition 1: False Identification

Sixty-eight out of the 87 randomly selected samples (78%) contained at least one taxon falsely identified by the volunteer. However, the majority of the samples containing falsely identified taxa were in error by only 1 or 2 taxa (21 and 28 samples, respectively) (Figure 4). The highest number of falsely reported taxa was 13 taxa. In this sample, the volunteer reported the presence of 16 taxa. Upon verification it was determined that the sample contained only 4 taxa. It was apparent this volunteer, or volunteer group, did not receive proper macroinvertebrate identification training or did not seek additional assistance with the identification of their sample. The remaining randomly selected samples showed that the majority of the volunteers of Illinois RiverWatch did receive enough training to accurately identify most of the taxa within their sample.

Bloodworms were most often falsely identified in the randomly selected samples. Bloodworms were falsely identified in 23 of the 87 (26%) randomly selected samples. Non-hydropsychid caddisflies and OTHER flies were falsely identified in 12 of the 87 samples (14%). Aquatic worms were falsely identified in 10 samples (11%). Limpets were the only taxa not falsely identified by volunteers. Table 4 provides information on the rates of false identification of all 33 indicator taxa identified by the program for 1997.

Since 1995, the misidentification of midge larvae (Order Diptera: Family Chironomidae or other midge family taxa) for bloodworms (Order Diptera: Family Chironomidae) by volunteers has been a common identification error. Volunteers were made aware of the importance of the correct identification of these organisms in previous years (i.e., 1995 and 1996) through training workshops and educational handouts. Currently volunteers are trained to look for the presence of ventral tubules on all midge larvae. Bloodworms are identified as those midge larvae possessing ventral tubules. Although most dipteran taxonomists would consider this method of differentiating bloodworms from other midges rather crude, ventral tubules of the bloodworm are the easiest, most distinguishable features of preserved bloodworms that can be observed at a magnification of 20X, the minimum magnification of microscopes used by the program.

Figure 4. The number of randomly selected macroinvertebrate samples that contained falsely identified taxa in 1997.

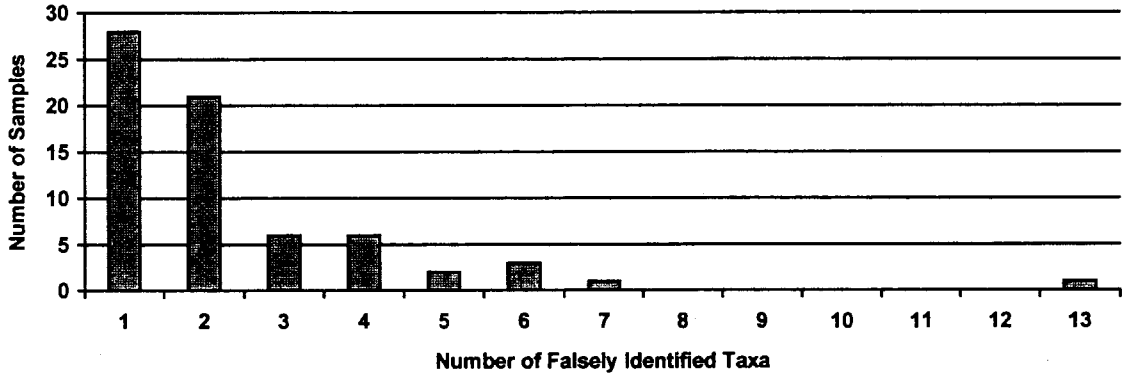


Table 4. Percentage of 1997 randomly selected samples containing falsely identified missed taxa.

Taxa	% of Randomly selected Samples Containing Falsely Identified Taxa
LIMPET	0%
LEECH	1%
SOWBUG	2%
CRAWLING MAYFLY	2%
BURROWING MAYFLY	2%
TWO-TAILED MAYFLY	2%
HYDROPSYCHID CADDISFLY	2%
BLACK FLY	2%
SNIPE FLY	2%
PLANORBID SNAIL	2%
DRAGONFLY	3%
NARROWWINGED DAMSELFLY	3%
STONEFLY	3%
WHIRLIGIG BEETLE	3%
WATER PENNY BEETLE	3%
MIDGE	3%
LEFT-HANDED SNAIL	3%
OPERCULATE SNAIL	3%
SCUD	5%
BROADWINGED DAMSELFLY	5%
HELLGRAMMITE	5%
FLATWORM	6%
BITING MIDGE	6%
CRANE FLY	7%
TORPEDO MAYFLY	8%
SWIMMING MAYFLY	8%
CLINGING MAYFLY	8%
RIFFLE BEETLE	8%
RIGHT-HANDED SNAIL	8%
AQUATIC WORM	11%
NONHYDROPSYCHID CADDISFLY	14%
OTHER FLY	14%
BLOODWORM	26%

I am not sure of the reasons behind the false identification of non-hydropsychid caddisfly larvae and aquatic worms by volunteers. I speculate that this identification error could be due to the lack of training materials. Non-hydropsychid caddisfly larvae are those caddisflies not belonging to the Family Hydropsychidae and are not collected as often as hydropsychid caddisfly larvae by RiverWatch volunteers. The rarity of this particular taxa group in volunteer collections results in few volunteers who encounter this organism on a yearly basis. Subsequently, this reduces the accuracy at which program volunteers can correctly identify the non-hydropsychid caddisfly larvae compared to some other taxa that are collected more commonly.

I recommend that the program provide additional training and training materials to help to alleviate these identification problems. First, the program should continue to review the characteristics of bloodworms during macroinvertebrate training sessions and refresher workshops. An exercise consisting of a mixed sample of midge larvae and bloodworms for the volunteers to sort is suggested. The midge/bloodworm sorting station would help hone the volunteers' skills at distinguishing these two organisms from one another. Teaching collections of macroinvertebrates should contain specimens of non-hydropsychid caddisfly larvae to provide the volunteers with additional training aids. The program should also provide field guides or identification cards containing color photographs or good drawings of all stream macroinvertebrates. Materials such as these would be helpful to the volunteers when faced with an unfamiliar organism in their sample.

4.3.2 Condition 2: Missed Identification

Overall, volunteers missed very few of the taxa in their samples. Forty-eight of the 87 randomly selected samples (57%) contained at least one taxa identified by the QC but not by the volunteer (missed taxa). Thirty-four of these samples, or 39% of the total 87 randomly selected samples, had no more than 1 missed taxa (Figure 5). Ten samples (11% of the 87 randomly selected samples) had two missed taxa in the samples. There were 4 samples that each had 3, 4, 5, and 6 missed taxa. No sample had more than 6 missed taxa. Table 6 provides the information on 48 randomly selected samples that contained at least one missed taxa.

Figure 5. The distribution of the number of missed taxa among those 48 randomly selected macroinvertebrate samples that contained missed taxa.

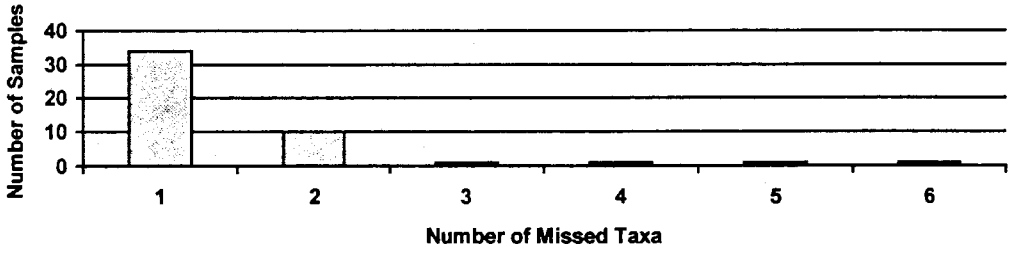


Table 6. Percentage of randomly selected samples that contained individually missed taxa in 1997.

Taxa	% of Randomly selected Samples Containing Missed Taxa
BROADWINGED DAMSELFLY	0
STONEFLY	0
WHIRLIGIG BEETLE	0
WATER PENNY BEETLE	0
PLANORBID SNAIL	0
OPERCULATE SNAIL	0
LEECH	1
SCUD	1
HELLGRAMMITE	1
TORPEDO MAYFLY	1
CLINGING MAYFLY	1
BURROWING MAYFLY	1
BITING MIDGE	1
SNIPE FLY	1
LEFT-HANDED SNAIL	1
RIGHT-HANDED SNAIL	1
LIMPET	1
FLATWORM	2
SOWBUG	2
DRAGONFLY	2
CRAWLING MAYFLY	2
NONHYDROPSYCHID CADDISFLY	2
OTHER FLY	3
NARROWWINGED DAMSELFLY	5
HYDROPSYCHID CADDISFLY	5
RIFFLE BEETLE	5
BLACK FLY	5
SWIMMING MAYFLY	6
CRANE FLY	6
BLOODWORM	6
MIDGE	6
AQUATIC WORM	7
TWO-TAILED MAYFLY	7

The data were analyzed by individual taxa to determine the most commonly missed taxa overall. Overall, very few taxa were missed by volunteers. Six samples, or 7% of the total, contained missed aquatic worms and two-tailed mayflies, the two most commonly "missed" taxa by volunteers. Swimming mayflies, craneflies, bloodworms, and midges were missed in 5 samples (6% of the total). Narrowwinged damselflies, hydropsychid caddisflies, riffle beetles, and blackflies were missed by volunteers in four of the samples (5% of the total).

The reasons for volunteers missing these particular taxa is not known. It is suspected that some of these taxa were actually misidentified as similarly looking taxa by the volunteers. This kind of identification error is discussed in the next section of this report.

Volunteers should be taught how to properly sort a macroinvertebrate sample. By properly sorting a sample into distinct groups of organisms one would be less apt to miss taxa that are either few in number, or that closely resemble other taxa in a sample. Recommendations for a sample sorting exercise is provided later in this report. Another suggestion is to provide more visual training aids for the volunteers to have on hand while sorting their sample. These training aids could be macroinvertebrate identification cards or an illustrated identification guide.

4.3.3 Condition 3: Mixed Identification

The identification of "mixed" taxa, or where a volunteer commonly misidentifies a taxon for a similar looking taxon, is a difficult condition to

ascertain since the data does not always indicate which taxa were misidentified for another. However, I was able to identify a specific number of individuals in a sample belonging to one taxon that were identified by the volunteer as belonging to another similar looking taxon. The mixed identification of bloodworms for midges or of narrowwinged damselflies for broadwinged damselflies were the two most common error of this type found in the volunteer samples. Some of the falsely identified and missed taxa (Identification Error Conditions 1 and 2, respectively) were commonly mistaken for each other. For example, midges were commonly misidentified as bloodworms, and two-tailed mayfly larvae were misidentified as swimming mayfly larvae.

Recommendations related to improving macroinvertebrate training concerning mixed taxa are similar to those recommendations related to missed taxa. A sorting exercise should be provided to volunteers during training and refresher workshops. The most efficient method of sorting is to separate the sample into groups of similar looking organisms in a Petri dish. Then each group of similar organisms is sorted further into specific taxa groups. The breaking down of a sample into separate groups, then into even smaller more defined groups causes one to look very closely at each organism in their sample and helps one to find the smaller organisms that may be hidden by larger ones. A proposed educational handout is provided in Appendix A of this report. Identification cards showing the differences and similarities of the most commonly mixed taxa would be beneficial to the volunteer during the sorting of their sample as well.

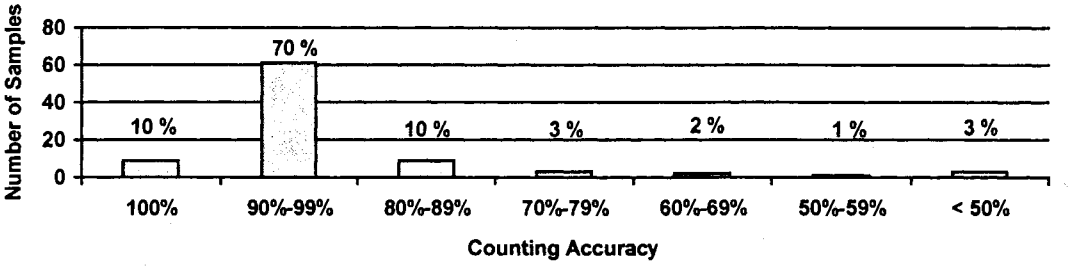
5. COUNTING ERRORS OF MACROINVERTEBRATE SAMPLES

Correctly counting the number of indicator stream macroinvertebrates in a sample is as important as the correct identification of the macroinvertebrate taxa. The number of organisms in a sample is referred to as sample density (D). For purposes of the Illinois RiverWatch program, the sample density of stream indicator macroinvertebrates is determined primarily for the purpose of calculating the macroinvertebrate biotic index (MBI) for the sample. The MBI is calculated as the average tolerance value for the sample where the sum of tolerance values are divided by the total number of indicator organisms in the sample.

The 87 samples randomly chosen for verification were observed for differences in sample densities between the QC (D_{QC}) and the volunteers (D_V). First, D_V / D_{QC} was calculated to observe overall counting accuracy. Seventy-nine, or 90% of the samples had D_V within 80% - 100% of D_{QC} (Figure 6). Then counting accuracy for the randomly selected samples were determined by percent deviations and calculated by the following formula:

$$D_V - D_{QC} \ / \ D_{QC} * 100 \qquad \text{eqn. 1}$$

Figure 6. Determination of overall counting accuracy of RiverWatch volunteer samples[1].



[1]Overal counting accuracy was determined by dividing the volunteer sample density (D_V) by the QC sample density D_{QC}).

Percent deviations determine how close volunteer sample density values were to QC sample density values. First, volunteer samples that had sample density values within 5% of the QC sample density were identified. Thirty samples (34% of the total) had volunteer sample density values that were not greater than 5% of the QC sample density values. Second, volunteer samples that had sample density values within 10% of the QC sample density value were identified. Here, 63 samples (72% of the total) had sample density values in agreement between the volunteer and the QC. Overall, Illinois RiverWatch volunteers counted their samples with 90% or greater accuracy.

The most frequently miscounted taxa were also identified. Individual counts of each taxon in each sample were compared between the volunteer and the QC. Instances where volunteers counted fewer individuals and where volunteers counted more individuals than the QC were evaluated separately.

Of the 33 indicator taxa, midges were miscounted the most (Table 7). Volunteers counted fewer midges in 25 samples (29%) of the 87 randomly

Table 7. Counting errors by taxa.

Taxa	Number of Samples		
	Counted Greater[1]	Counted Fewer[2]	Agree in Count[3]
SNIPE FLY	0	0	0
OPERCULATE SNAIL	0	0	2
BURROWING MAYFLY	0	0	2
WATER PENNY BEETLE	0	0	3
LIMPET	1	0	1
PLANORBID SNAIL	2	0	2
HELLGRAMMITE	0	0	4
WHIRLIGIG BEETLE	0	0	5
NONHYDROPSYCHID CADDISFLY	3	2	0
DRAGONFLY	0	0	6
BITING MIDGE	1	2	4
RIGHT-HANDED SNAIL	0	0	7
TORPEDO MAYFLY	1	3	4
BROADWINGED DAMSELFLY	2	1	8
CRANE FLY	1	0	5
TWO-TAILED MAYFLY	2	4	2
OTHER FLY	0	1	10
NARROWWINGED DAMSELFLY	2	2	7
CRAWLING MAYFLY	1	1	11
STONEFLY	3	5	8
BLOODWORM	6	2	4
FLATWORM	5	3	8
LEECH	5	1	11
CLINGING MAYFLY	6	2	13
SWIMMING MAYFLY	10	6	8
SCUD	13	3	19
AQUATIC WORM	16	3	12
LEFT-HANDED SNAIL	6	5	25
RIFFLE BEETLE	6	5	29
HYDROPSYCHID CADDISFLY	6	14	23
SOWBUG	12	11	29
BLACK FLY	18	12	21
MIDGE	32	25	13

[1]*Counted Greater = The volunteer counted more individuals of the specified taxa than the Quality Control Officer.*

[2]*Counted Fewer = The volunteer counted fewer number of individuals of the specified taxa than the Quality Control Officer.*

[3]*Agree in Count = The volunteer counted the same number of individuals of the specified taxa as the Quality Control Officer.*

selected samples, and counted more midges in 32 samples (37%). Other taxa commonly miscounted by the volunteers were black fly larvae, aquatic worms, and hydropsychid caddisfly larvae. Volunteers counted fewer black fly larvae compared to the QC in 12 samples (14%), and counted more black fly larvae than QC in 18 samples (21%). Volunteers counted more aquatic worms in 16 (18%) of the randomly selected samples, and counted fewer hydropsychid caddisfly larvae in 14 (16%) of the randomly selected samples.

Were volunteer counting errors more common with those taxa that were commonly collected with higher density? It would make sense that one would miscount 100 organisms compared to counting only 10 organisms. One could assume that a volunteer would "lose count" while counting a large number of individuals compared to counting only a few individuals. To determine this relationship, the density of each of the most commonly miscounted taxa were observed. Surprisingly, sowbugs were collected with the highest density (1,513 individuals) in the randomly selected samples overall. However, there were only 6 samples (7% of total) that contained miscounted sowbugs. The most commonly miscounted taxa, namely midge larvae, black fly larvae, and hydropsychid caddisfly larvae, were the next most abundant taxa collected with 1325, 901, and 707 individuals, respectively.

The question then becomes why weren't sowbugs miscounted as often as the other most commonly miscounted taxa? The obvious reason would be the familiarity of the volunteers with sowbugs. Volunteers tend to identify sowbugs readily after little training because of the similar appearance to the terrestrial

sowbug or pillbug. The size of the sowbugs could also be a factor. It is considered easier to correctly count a set of larger organisms compared to a set of much smaller organisms. Sowbugs are larger, in general, compared to the other miscounted taxa.

Aquatic worms are difficult to count since their bodies break up in the alcohol in which they are preserved. I determined the number of anterior worm sections in a sample. Since volunteers always counted more worms in their samples compared to my assessment of the number of worms, I assumed that the volunteers were counting all worm parts, both anterior, posterior, and middle sections. Volunteers should be instructed to located two worm "ends" in their sample to represent one worm since it is difficult to determine which end is anterior or posterior. The volunteer should add the number of whole worms to the number of represented worms as the number of total aquatic worms in the sample. Although counting the pairs of worm ends is not as accurate as counting the actual worm, I feel that this method will prevent the volunteers from reporting an inaccurate number of worms in their sample.

The program should train volunteers to use a common counting procedure practiced by various professions to help them count their samples with less error. Illinois RiverWatch trainers should instruct volunteers to first sort their sample using the procedure mentioned earlier. Then the volunteers should be instructed to count each taxa group within their sample by groups of 5 or 10. For example, after a sample has been sorted into distinct taxonomic groups, I begin to count the sample. The most numerous group of organisms is counted

first by forming smaller groups of 10 individuals in separate spaces in a Petri dish. Any remaining organisms that are in number less than 10 are placed aside. The number of groups of 10 plus the number of remaining organisms are added together to gain the total number of individuals per taxa. For example, 4 groups of 10 individual hydropsychid caddisfly larvae plus 4 remaining hydropsychid larvae would equal 44 hydropsychid caddisfly larvae for the sample.

The training exercise may consist of a study station in a laboratory setting where 2-3 samples of macroinvertebrates of known densities would be available for the volunteers to sort and count. Appendix A contains an example of a macroinvertebrate sample counting and sorting exercise to use at a study station for a volunteer training workshop. Data sheets containing the correct information for each sample could be posted at another study station so that the volunteers can assess their own progress. The handout on the sorting procedure could also be handed to volunteers to take home to allow for self-study.

6. COMPARISON OF QUALITY CONTROL OFFICER DETERMINED MBI (MBI_{QC}) AND VOLUNTEER DETERMINED MBI (MBI_V) VALUES

The macroinvertebrate biotic index or MBI was developed by the Illinois Environmental Protection Agency (IEPA 1989) as a means of determining stream quality using benthic macroinvertebrates (Table 8). The IEPA uses Illinois RiverWatch MBI values to add to their biannual 305b report which evaluates water quality on a statewide basis. Since Illinois RiverWatch MBI values are used as an indication of stream quality by both the program and IEPA, I wanted to determine if the volunteer macroinvertebrate identification errors would significantly affect stream quality ratings. To determine the accuracy of Illinois RiverWatch MBI values to assess stream quality several comparisons were made between the QC calculated MBI and the volunteer calculated MBI of the same samples.

Table 8. Stream quality ratings based on Illinois Protection Agency's Macroinvertebrate Index (MBI) values.

STREAM QUALITY RATING	MBI VALUE
GOOD	Less than 6.0
FAIR	6.1 - 7.5
POOR	7.6 - 9.0
VERY POOR	Greater than 9.0

6.1 One-way t-Test Analysis

A paired t-test was performed on the data using a confidence interval of 95%. Table 9 shows the results of this analysis. No significant differences were found between the MBI values calculated from macroinvertebrate data

determined by the QC and the volunteers ($p < 0.5$). This analysis showed that volunteer MBI values were not significantly different from the QC values overall.

Table 9. Results from the paired t-test of volunteer and quality control determined (QC) determined MBI values.

Statistic	QC MBI[1]	Volunteer MBI[2]
Mean	5.8	5.7
Variance	1.4	4.3
Observations	87	87
Pooled Variance	1.3	
Degrees of Freedom	172	
t-Statistic	0.6*	*no significant difference
P(T≤ t), Two-Tail	0.6*	between mean MBI values
Critical Two-Tail t value	2.0	

[1]QC MBI = MBI calculated from volunteer-collected samples using the identification data by the quality control officer.
[2]Volunteer MBI = MBI calculated from original volunteer data for 1997.

6.2 Percent Deviation Analysis

Volunteer and QC determined MBI values were also compared by percent deviations. The percent deviation is the difference between the volunteer value and the QC value divided by the QC value:

$$(MBI_V - MBI_{QC}) / MBI_{QC} * 100 \qquad \text{eqn. 2}$$

The percent deviation between two variables provides information on how far apart two values are from one another. In this case, I was investigating how close MBI values calculated from volunteer macroinvertebrate identification data were from MBI values calculated with my identification data of the same sample. Three levels of acceptance were chosen for this comparison, 5% (95% accuracy), 10% (90% accuracy), and 20% (80% accuracy). MBI comparisons that yielded percent deviations greater than 0.049, 0.099, and 0.199 were

rejected. Rejected comparisons were considered significantly different at $p < 0.05$, $p < 0.10$, and $p < 0.20$ levels. Since the previous two tailed t-test showed no significant differences between MBI_V and MBI_{QC} it was expected to find a small percentage of the MBI comparisons to fall outside the 10% rejection. Twenty-three MBI_V values (26%) differed from MBI_{QC} by 5% or more. Eleven MBI_V values (13 %) differed from MBI_{QC} by 10 % or more. Only one (1%) MBI value differed from MBI_{QC} by more than 20% where the percent deviation was 36.5%.

This analysis showed that although volunteer MBI values were not considered significantly different from QC values overall as indicated by the paired t-test, there was a percentage of those values that did differ based on percent deviations. However, only 1% of the samples differed by 20% error.

6.3 Confidence Interval Comparison

MBI values are merely the average value of the all tolerance values represented by the indicator organisms in a sample. Since MBI values are averages, 95% confidence limits can be determined. Ninety-five percent confidence intervals were calculated for all MBI_{QC} values using the following equation:

$$(CI = MBI \pm SE(1.96)) \qquad \text{eqn. 3}$$

where CI = 95% confidence interval, MBI = QC determined MBI value, SE = mean standard error of the MBI, and $1.96 = t_{.05,\,86}$.

If the MBI_V fell within the 95% confidence interval for MBI_{QC}, the value was accepted as being not significantly different ($p < 0.05$) from the MBI_{QC}. If the

MBI_V did not fall into the interval, then the value was rejected and considered to be significantly different from the MBI_{QC} at $p < 0.05$. Eighteen MBI_V values (21%) did not fall within corresponding MBI_{QC} 95% confidence intervals (Table 10). Sixty-nine (79%) of the MBI_V values were within the 95% confidence intervals of the MBI_{QC}. These results support the non-significant difference findings of the t-test analysis of the MBI values, but do indicate which MBI_V values were affected by identification and enumeration errors.

Table 10. Eighteen volunteer-calculated MBI values that did not fall within 95% confidence intervals of corresponding QC calculated MBI values.

Site Number	MBI_{QC}	95% CI	Sample Size (N)	MBI_V
R1017301	5.5	5.7 - 5.3	85	5.8
R0100501	5.6	5.8 - 5.4	64	5.9
R0212902	7.3	7.6 - 6.9	99	6.8
R0212208	7.5	7.9 - 7.2	84	8.0
R0210001	6.9	7.9 - 5.9	9	8.2
R0701701	6.1	6.1 - 6.0	220	6.2
R1003501	4.9	5.5 - 4.3	34	4.0
R1009601	5.8	6.1 - 5.6	38	5.3
R0806401	4.3	4.6 - 4.0	89	4.7
R0301001	5.0	5.3 - 4.6	75	4.0
R0617201	6.2	6.5 - 5.9	96	6.5
R0402802	6.3	6.7 - 5.9	93	5.5
R0614901	5.5	5.7 - 5.3	91	4.9
R0620301	9.9	11.0 - 8.7	16	6.3
R0611202	6.3	6.5 - 6.1	93	5.9
R1000401	5.7	5.9 - 5.5	49	5.0
R0214501	7.6	8.0 - 7.2	92	6.9
R0701101	5.3	5.5 - 5.1	88	5.0

6.4 Interpretation of the Differences/Similarities Between MBI_{QC} and MBI_V Values

No significant differences ($p < 0.05$) were found between the two MBI data sets overall (i.e., QC and volunteer MBI values). However, four out of the 87 MBI comparisons (5 % of the total number of sites) did not agree with reference to stream quality rating. These four data sets varied in volunteer macroinvertebrate identification accuracy from 60 % to 0 % (Table 11). Overall, the results indicate that errors in the identification of stream indicator macroinvertebrates by volunteers did not significantly affect the numerical values of the MBI's. However, identification error can affect the stream quality rating inferred by MBI values calculated from volunteer-collected data. Previous recommendations concerning the improvement of macroinvertebrate identification training by the addition of training materials and exercises would improve the accuracy of volunteer MBI values.

Table 11. Four of the 87 randomly selected macroinvertebrate samples that were in disagreement with randomly selected MBI values and stream quality ratings.

Site Number	Accuracy Rate[1]	Volunteer MBI and Stream Quality Rating[2]	QC MBI and Stream Quality Rating[3]
R0210001	60 %	8.2, POOR	6.9, FAIR
R0611202	25 %	5.6, GOOD	6.3, FAIR
R0402802	18 %	5.5, GOOD	6.3, FAIR
R0620301	0%	6.3, FAIR	9.9, VERY POOR

[1]Accuracy rate calculated by the division of the number of correctly identified taxa in an individual taxa by the number of taxa identified by QC in that sample.
[2]Volunteer MBI and stream quality rating based on original data submitted by 1997 volunteers.
[3]MBI and stream quality rating based on verification of volunteers samples by quality control officer (QC).

7. DATA SHEET ERRORS

The recording of data at the stream site onto the data sheets is the first step of data collection for the Illinois RiverWatch stream monitoring program. Volunteers are trained to follow written stream monitoring procedures and to place the information or data onto one of three Illinois RiverWatch data sheets , i.e. Habitat Sketch, Habitat Survey, and Biological Survey data sheets. The accuracy of the data is dependent upon the volunteer properly conducting monitoring procedures and accurately recording data.

Volunteers are required to submit original data sheets, along with a macroinvertebrate sample to a regional EcoWatch office after monitoring their respective stream site. EcoWatch trainers then review the data sheets before entering data into the regional database files. EcoWatch trainers are instructed to note any data sheet errors in a NOTES field in the database files. I review these notes to obtain information on the completion of data sheets by Illinois RiverWatch volunteers.

Only nineteen (6 %) out of the 293 accepted data sheet sets did not have the verification boxes signed and dated by the volunteers. Volunteers are taught to check over their data sheets after each procedure is completed, and to sign and date the first or second line in the verification boxes on their data sheets. The signature and date in the verification box indicates that the volunteer has checked over the data on the data sheet and the information is as complete and correct to the volunteer's knowledge. Another more important reason for the verification of the data sheets by the volunteer is to force the volunteer to double

check the information recorded on the data sheet. However, the presence of signatures and dates in the verification boxes on the data sheets did not prove to be an indication of the lack of errors on the data sheets.

EcoWatch offices reviewed the data sheets before data entry. Each trainer was instructed to record the type of data entry error found on the data sheets and to report this information to my office. From this survey, thirty-one (10.5%) of the data sheet sets contained one or more of the following data entry errors:

1. missing data on special interest species
2. missing temperature data (for air or water)
3. incomplete discharge calculations
4. use of older versions of the data sheets
5. missing weather conditions data
6. missing watershed characteristics data
7. incorrect data entry for bottom substrate information
8. incorrect data entry for stream turbidity information
9. missing end time
10. missing start time
11. missing information on streamside vegetation
12. MBI calculation error
13. error in the calculation of percent composition of EPT and CW taxa
14. sample density calculation errors

The majority, or 89.5% of the data sheets did not have any noticeable errors. Therefore it is assumed that the majority of volunteers are checking over their data sheets at the stream site and in the laboratory while identifying the macroinvertebrate sample.

Volunteers are instructed to leave notes on their data sheets concerning any occurrence or situation they feel would be important to the program with regards to the data or the stream site. Notes written on the data sheets by the

volunteer help to determine if missing data were due to neglect, improper procedures, or to some other uncontrollable factor. For example, some volunteers indicated that streams were very shallow, and that velocity could not be determined. No error in data sheet completion was determined for missing stream velocity or stream discharge data for these data sheets.

Illinois RiverWatch volunteers did check their data sheets before submitting to the regional offices. As stated above, only slightly more than 10% of the data sheet sets submitted by volunteers in 1997 had data entry errors. Volunteers should be continually encouraged to verify their data sheets before submission to maintain an equivalent or higher level of data entry accuracy in future years.

8. CONCLUSIONS AND RECOMMENDATIONS

Overall, the volunteers of the Illinois RiverWatch stream monitoring program are working at the expected level of 80% accuracy with regards to macroinvertebrate identification, sample sorting and counting, and data entry accuracy. However, mistakes in the identification of stream macroinvertebrates, sorting and counting samples, and in data entry were found. Therefore, it is recommended that the Illinois RiverWatch program enhance some aspects of volunteer training in order to improve the program's level of accuracy. The following are recommendations provided for Illinois RiverWatch:

1) Illinois RiverWatch trainers should train volunteers to correctly distinguish bloodworms from midges.

2) Illinois RiverWatch should house at least one reference collection that contains all stream macroinvertebrate for use by volunteers at each regional office.

3) Volunteer training should include exercises where volunteers 1) differentiate infrequently collected organisms from other more commonly collected organisms and 2) positively identify taxa that have been determined by this study to be commonly incorrectly identified. The following list are suggestions for petri dish contents to be used as training exercises:

   - bloodworms and midges
   - broadwinged damselfly larvae and narrowwinged damselfly larvae

- hellgrammite larvae and whirligig beetle larvae
- two-tailed mayfly larvae, stonefly larvae, and swimming mayfly larvae
- left-handed snails and right-handed snails
- riffle beetle larvae and hydropsychid caddisfly larvae
- hydropsychid caddisfly larvae and non-hydropsychid caddisfly larvae

4) Volunteers should be instructed how to count the number of aquatic worms in their samples with better accuracy. The program should instruct volunteers to count the number of worm "end" pairs in their sample and not to count all worm parts in their sample as individual worms.

5) More visual training aids are needed for volunteer macroinvertebrate identification. This recommendation is mentioned throughout this report as a solution to many of the macroinvertebrate identification problems. Waterproof macroinvertebrate identification cards that can be easily carried by the volunteer to the stream site and to the laboratory would be an excellent tool. The program currently provides a macroinvertebrate study guide which many volunteers have found helpful. A more descriptive macroinvertebrate identification key written in such a way that someone with very little or no scientific education could easily understand is also recommended.

6) Illinois RiverWatch volunteers should be trained to properly sort their samples. If volunteers sort their samples more efficiently, they may

become more proficient at identifying all organisms in their sample. It is recommended to add the sorting exercise mentioned in this report to volunteer training.

7) To correct for inaccurate counting of organisms in a macroinvertebrate sample, I recommend that the program add a counting exercise to volunteer training. The counting exercise mentioned in this report is easy and straightforward. A volunteer could either use the exercise to hone their skills at a workshop or at home.

8) The verification of the data sheets by the volunteers before submission is very important to data quality. The program should emphasize the importance of data sheet verification to volunteers during training workshops, refresher workshops, and through other means of communication.

In addition to these recommended program changes, a more thorough survey of data sheet errors will be conducted in 1998. Regional offices will complete a survey form for each set of data sheets submitted to their office. The completed forms will then be submitted to QC for analysis. A report of these findings will be submitted in 1999. Appendix B contains a proposed data sheet verification form for use in 1998.

Other planned activities for 1998 are comparison studies; two studies will be performed. One study will compare the accuracy and comparability of Illinois RiverWatch volunteer-collected data to Illinois Natural History Survey professionally collected data for use in the Critical Trends Assessment Project.

This study will show how well the Illinois RiverWatch volunteer data compare to the data collected for use in the Critical Trends Assessment Project. Dr. E. DeWalt will conduct professional level surveys on streams that Illinois RiverWatch volunteers monitor. The two sets of data will be compared and recommendations will be presented. The other study will focus on the volunteers of the program. I will verify the data and macroinvertebrate samples of volunteers of different affiliation and years of experience. In this study, data collected from new volunteers will be compared to volunteers with more than one year of experience in the program. High School science teachers participating in the PLANIT program will also be observed and their data will be compared to those from the rest of the program volunteers. The results from this study will provide the program with information regarding the success of volunteers over time and with the success of PLANIT training sessions and support.

Another study will determine minimal sample size of macroinvertebrate samples to verify. Currently, I verify 30% of all samples collected in one year of the program. I chose to verify thirty percent of the samples so that a good representation of the variability of the volunteers' abilities to identify macroinvertebrates would be available. With my new responsibility to conduct quality control checks on additional EcoWatch programs, and with the success of the Illinois RiverWatch volunteers in identifying macroinvertebrates, I will determine if 10% of all samples will suffice in providing the program with enough information for quality control purposes.

9. LITERATURE CITED

IEPA. 1989. Biological stream characterization (BSC): A biological assessment of Illinois stream quality. Special Report of the Illinois State Water Plan Task Force. Illinois Environmental Protection Agency, Division of Water Pollution Control, Springfield, IL. 48 pp.

Kelley, W. D., T. A. Ratliff, Jr., and C. Nenadic. 1992. *Basic statistics for laboratories: A primer for laboratory workers.* Van Nostrand Reinhold. New York. 175 pp.

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10. APPENDICES

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10.1 APPENDIX A

SORTING AND COUNTING A MACROINVERTEBRATE SAMPLE.

A proposed training exercise for Illinois RiverWatch volunteers.

RiverWatch

SORTING AND COUNTING YOUR MACROINVERTEBRATE SAMPLE

WHAT YOU WILL NEED:

1. Your macroinvertebrate sample
2. RiverWatch Biological Survey data sheet (Macroinvertebrate Identification)
3. 2 - 3 Petri dishes
4. Forceps
5. Pen or pencil
6. A supply of alcohol
7. A microscope of at least 20X, but not exceeding 40X

PROCEDURE:

1. POUR YOUR SAMPLE INTO ONE OF THE PETRI DISHES.

Make sure that there is enough alcohol in the dish to cover your sample completely. Add more alcohol if needed.

2. **SORT THE SAMPLE INTO GROUPS OF SIMILAR LOOKING ORGANISMS.**

For example, group all of the mayfly larvae together and place them in one area of the Petri dish. Place all of the sowbugs together in another area, etc. When finished with this initial sorting, you should have several groups of similar organisms in the dish. If your sample contains a lot of organisms, you may have to use a second Petri dish for additional space. Be sure to cover the organisms in the second dish with alcohol to prevent them from drying out.

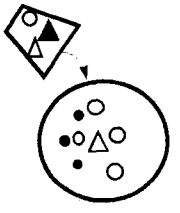
3. **SORT EACH GROUP OF SIMILAR ORGANISMS INTO SMALLER GROUPS BASED ON THE TAXA LISTED ON THE DATA SHEET.**

For example, sort the group of mayfly larvae into smaller taxa groups such as torpedo mayfly larvae, crawling mayfly larvae, clinging mayfly larvae, etc. Again, you may use a second, or even a third Petri dish if you need additional space for the various organism groups that you form.

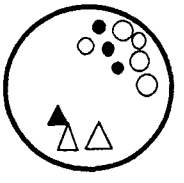
Examine each organism in a group to make sure that it belongs. Remove any organism that does not belong and place it with another, more appropriate group.

After you are confident that each group contains individuals of the same taxa, count the number of organisms in each group.

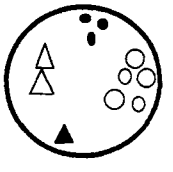
1.



2.



3.

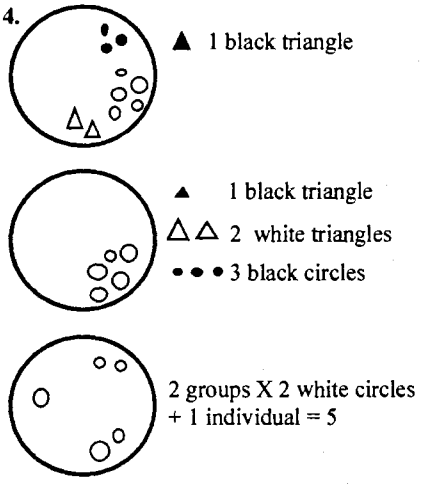


4. BEGINNING WITH THE LEAST NUMEROUS GROUP OF ORGANISMS IN THE PETRI DISH, IDENTIFY AND COUNT EACH GROUP SEPARATELY.

Starting with the least numerous group and working to the most numerous group frees up space in the Petri dish. You will need this space later to count the more numerous groups of organisms in your sample.

The best way to keep track of counting is to create even smaller groups of 5 or 10 organisms from a larger group. Once the larger, original group of organisms is broken down in to these smaller groups, simply count the number of smaller groups, plus any "extra" organisms. For example, suppose a large group of hydropsychid caddisfly larvae is divided into 4 groups of 10, with 7 larvae left over. This would result in a count of 47 hydropsychid caddisfly larvae ((4 groups X 10 individuals) + 7 extra individuals = 47).

4.



TIP:
After counting a large group of organisms, count them one more time. If you arrive at the same number of organisms on the second try, then you have probably counted the organisms correctly. If you do not come up with the same answer on the second try, count the group again. You should count the group until you arrive at the same answer two times in a row.

5. ENTER THE DATA ON THE DATA SHEET.

Once you are satisfied with the identification and number of organisms for each group, write this number in the correct space on the data sheet. Place the organisms back into the sample jar when you are through with each group. Be sure to cover the sample with additional alcohol if needed and keep the jar closed to prevent evaporation.

5.

DATA SHEET

Black triangle	1
White triangle	2
Black circle	3
White circle	5
TOTAL	11 ✓

10.2 APPENDIX B
DATA SHEET VERIFICATION WORKSHEET

A proposed data sheet for the purpose of detecting volunteer data sheet errors.

ILLINOIS ECOWATCH NETWORK
VOLUNTEER DATA SHEET VERIFICATION FORM
1998

Site ID Number:_____ Macroinvertebrate sample submitted? Y N
Regional Office: _____
Person conducting this survey: _____
Date that data sheets were received by your office: _____
Were the data sheets _____copies? _____originals? _____Old Data Sheets (95 0r 96)
(Check all that apply)

Verify the following data sheet characteristics by answering the following questions:

A. ALL DATA SHEETS

1. Are the site identification boxes filled out correctly? Y N

If NO, what information is missing from the site identification box? (Check one or more of the following)

☐ Site identification number

☐ Stream name

☐ County

☐ Date

If YES, can you read the information in the Site Identification Box? Y N

2. Did the volunteer(s) write special notes or comments on the data sheets? Y N
3. Did the volunteer(s) sign or initial and date the verification boxes on each data sheet? Y N

B. Habitat Sketch Sheet

1. Did the volunteers indicate the locations of macroinvertebrate collection on the sketch? Y N
2. Did the volunteers indicate the direction of North on the sketch? Y N
3. Did the volunteers indicate the direction of water flow on the sketch? Y N
4. Did the volunteers indicate the transect across which stream discharge was measured on the sketch? Y N

C. Data Processing Questionnaire

1. Did the volunteers submit a data processing questionnaire along with the data sheets? Y N

D. HABITAT SURVEY DATA SHEET

1. Did volunteers provide information for all stream characteristics on first page of Habitat Survey Data Sheet? Y N

If NO, what stream characteristics did volunteers not provide information? (Check all that apply).

☐ Start time	☐ End Time	☐ Present Weather
☐ Weather in Past 48 hours	☐ Water Appearance	☐ Water Odor
☐ Turbidity	☐ Water Temperature	☐ Air Temperature
☐ Algal Growth	☐ Submerged Aquatic Plants	☐ Riparian Vegetation

☐ Canopy Cover ☐ Bottom Substrate ☐ Embeddedness

2. If the volunteer measured water temperature, did the volunteer circle a temperature unit? (e.g., F or C?) Y N
3. If the volunteer measured air temperature, did the volunteer circle a temperature unit? (e.g., F or C?) Y N
4. Does the sum of the various percentages of bottom substrate composition equal 100 percent? Y N
5. Did the volunteers complete the estimated stream discharge estimate section of the data sheet? Y N

If NO, check all that apply to possible errors:

☐ Stream width not measured

☐ Only 2 depth measurements ☐ Only 2 velocity measurements

☐ Only 1 depth measurement ☐ Only 1 velocity measurement

☐ No depth measurement ☐ No velocity measurement

☐ Average depth was not calculated ☐ Average velocity was not calculated

☐ Discharge estimate was not calculated.

4. Did the volunteers complete the watershed features survey? Y N
5. Did the volunteer answer the questions regarding the stream site? Y N

If NO, then provide what information was missing by checking one or more below:

☐ Upstream dam (indication and/or distance is missing)

☐ Wastewater discharge information (indication and/or distance is missing)

☐ Pipes entering stream site

☐ Channel alteration (indication and/or percentage of channelization)

6. Did the volunteer provide any additional notes or comments in the NOTES section of the data sheet? Y N

PROVIDE ANY COMMENTS OR NOTES WITH REFERENCE TO THE LEGIBILITY AND COMPLETENESS OF THE HABITAT SURVEY DATA SHEET BELOW. PROVIDE ANY ADDITIONAL COMMENTS THAT YOU FEEL ARE NECESSARY AS WELL.

Site ID Number:_____

D. Biological Survey Data Sheet

1. Did the volunteer indicate the presence of any special interest organisms?	Y	N
If YES, did the volunteer indicate the presence/absence of each organism?	Y	N
If NO, what organism was not indicated to be present or absent at the stream?		

☐ Native Mussel ☐ Zebra Mussel ☐ Fingernail Clam

☐ Asiatic Clam ☐ Rusty Crayfish

2. Did the volunteer indicate the two most diverse habitats sampled?	Y	N
3. Did the volunteer conduct subsampling procedures?	Y	N
If YES, then answer the following questions:	Y	N
A. Did the volunteer calculate the number of organisms per tray?	Y	N
B. What size grid did the volunteer use?	9	12

4. Was any of the below information missing on the data sheet?:	Y	N

☐ MBI

☐ Sample Density

☐ Taxa Richness

☐ % Composition Information

5. Did the volunteer provide any additional notes or comments in the NOTES section of the data sheet?	Y	N

PROVIDE ANY COMMENTS OR NOTES WITH REFERENCE TO THE LEGIBILITY AND COMPLETENESS OF THE BIOLOGICAL SURVEY DATA SHEET ON BACK OF THIS PAGE. PROVIDE ANY ADDITIONAL COMMENTS THAT YOU FEEL ARE NECESSARY AS WELL.